PRATHAMESH SARAF

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SKILLS

Programming/Modeling: C++ (11/14/17), Python, Embedded C, MATLAB/Simulink, Verilog/VHDL
Frameworks/Simulation: ROS/ROS2, Gazebo, MuJoCo, PyBullet, Drake, Isaac Sim/Omniverse, CARLA/LGSVL
Embedded Systems: CAN bus, EtherCAT/TwinCAT (Beckhoff), SPI/I^2C/UART, FPGA, Simulink HDL Coder
Robotics/Controls: PID, LQR, MPC, Whole-Body Control, Impedance Control, State Estimation (EKF/UKF, Particle Filters)
Testing/Validation: HIL/SIL, unit testing, regression testing, test benches, logging & data analysis, on-site debugging
Tools/Platforms: Git/GitHub, Docker, Linux (Ubuntu), Jira, CAD (SolidWorks, Fusion 360), Electrical CAD/Schematic Design
Soft Skills: Cross-functional collaboration, escalation, customer support, ownership, stakeholder management

EXPERIENCE

***Controls Engineer (System Integration)*, ASML** *Jun 2024 - Present*

- Led the closed-loop PI controller design for the energy subsystem by analyzing frequency/time-domain metrics (Bode, Nyquist, step/sine response) and system identification to improve performance, robustness, and bandwidth.
- Benchmarked and validated the controller gains using a multi-parameter cost function, simulation to match desired spec; deployed across multiple production systems; accepted as the new baseline configuration with **99.8%** efficiency.
- Implemented feedforward control, improving transient response, noise suppression, reference tracking, and overall reliability of the 5200B EUV lithography systems for known failure points and edge cases.
- Built and deployed an EtherCAT-based 'Sensor Acquisition' HIL simulator (Simulink-HDL), regression-tested on FPGA-based testbenches; extended a Python simulator for accelerated verification workflows.
- Led end-to-end delivery of open-loop control, updated requirements, and the Simulink model, designed test cases, performed unit/bench testing, and coordinated with cross-functional teams to deliver 3 weeks ahead of schedule.
- Provided rapid escalation and integration support by debugging issues in less than 1 day, delivering FW/control patches, and training proto engineers during feature bring-up.

***Dynamic Locomotion and Controls Researcher*, N Robotics | IISc | NUS** 🔗 *Jan 2021 - Sep 2023*

- Led the development of locomotion/gait planning using whole-body MPC controllers, ZMP planners, CPG-based approaches, inverted pendulum models, and motion imitation learning for humanoid, quadruped, and hexapod robots.
- Implemented EKF/UKF-based estimators, sensor fusion pipelines combining IMU, foot contact sensors, joint encoders, and LiDAR/vision to obtain terrain estimates and maintain accurate body pose during dynamic maneuvers.
- Designed and validated QP-based hierarchical task-space controllers through SIL/HIL testing, tuned torque parameters on hardware using joint feedback, and benchmarked performance on stability, slip, fall recovery, and energy efficiency.
- Collaborated cross-functionally to debug hardware issues like sensor drift, actuator nonlinearities, motor overheating, signal noise, latency, and foot contact misdetection in real time, ensuring stable execution under variable conditions.

***Electronics Subsystem Lead*, Hyperloop India** 🔗 *Aug 2019 - Oct 2020*

- Architected a CAN-based distributed vehicle control system with multi-sensor fusion (IMUs, encoders, tachometers, fiducials) for real-time state estimation and built-in fault diagnostics, achieving >90% error reduction.
- Implemented localized torque control loops and fail-safe Emergency Braking Protocols on motor controllers, improving safety and operational reliability to **98%** across propulsion, braking, and sensing modules as per ISO26262 principles.
- Designed and validated hardware-level safety protection through SIL/HIL testing for high-voltage systems, including battery management, arcing prevention, and robust power distribution to propulsion units for operational readiness.

RELEVANT PROJECTS

Traffic Wave Dampening using Autonomous Vehicles | *Python* 🔗 *Apr 2023 - Jun 2023*

- Modeled complex traffic flow dynamics using a state-space representation to validate Lagrangian control strategies for autonomous vehicles to dampen traffic waves and ensure system stability significantly.
- Implemented a Follower Stopper controller, reducing velocity standard deviation by **80.8%**, fuel consumption by **42.5%**, and excessive braking by **98.6%**, while concurrently increasing traffic throughput by **14.1%**.

Multi-Modal Sensor Fusion for Robotic Localization and Mapping | *Python* 🔗 *Jan 2023 - Mar 2023*

- Implemented comprehensive Simultaneous Localization and Mapping solutions for autonomous robots, fusing IMUs, encoders, 2D LiDAR (up to 30m range), and stereo/RGBD camera data to construct 2D occupancy grids to track landmarks.
- Optimized a Particle Filter for differential-drive robot localization and an Extended Kalman Filter (EKF) for visual-inertial SLAM, ensuring robust and accurate pose tracking.
- Validated high-fidelity sensor processing pipelines, encompassing IMU calibration, 10Hz yaw rate filtering, and gradient descent optimization for quaternion-based orientation tracking for precise vehicle control and panoramic mapping.

A Convolutional Neural Network Approach Towards Self-Driving Cars | *C++, Python* 🔗 *Sep 2018 - Mar 2019*

- Designed end-to-end control architecture with Raspberry Pi handling CNN-based perception/inference and Arduino Mega executing low-level motor actuation via PWM and CAN bus, achieving sub-millisecond inference latency.
- Implemented CNN-driven control mapping raw camera input to steering commands (Embodied AI), with ultrasonic sensor tracking and a safety layer to trigger obstacle avoidance, lane changes, and braking under real-time constraints.
- Integrated motion planning with RRT*-Connect + Reed–Shepp curves, validated in the CARLA simulator and on a hardware prototype, achieving an **86%** autonomy rate with robust real-time performance.

OTHER FIRST AUTHOR PUBLICATIONS / PROJECT REPORTS

1. "*Convex Optimization in Legged Robots*," Project Report
2. "*Implementation and Testing of Force Control on a Spherical Articulated Manipulator*," IEEE ICMA 2022
3. "*Terrain Adaptive Gait Transitioning for a Quadruped Robot using Model Predictive Control*," IEEE ICAC 2021 🔗
4. "*Modeling and Simulation of a Point-to-Point Spherical Articulated Manipulator Using Optimal Control*," IEEE ICARA 2021
5. *"A Comparative Study Between a Classical and Optimal Controller for a Quadrotor*," IEEE INDICON 2020

EDUCATION

University of California, San Diego San Diego, USA
MS in Electrical & Computer Engineering (Intelligent Systems, Robotics, & Controls) *2022 - 2024*
Courses: Robot Motion Planning, Sensing and Estimation, Co-operative Control of Multi-Agent Systems, Statistical Learning, Convex Optimization, Linear Algebra, Non-Linear Controls, Stochastic Processes in Dynamic Systems, AI for Robotics

Birla Institute of Technology & Science, Pilani Hyderabad, India
B.E. Electronics & Instrumentation; Minor in Robotics & Automation *2017-2021*